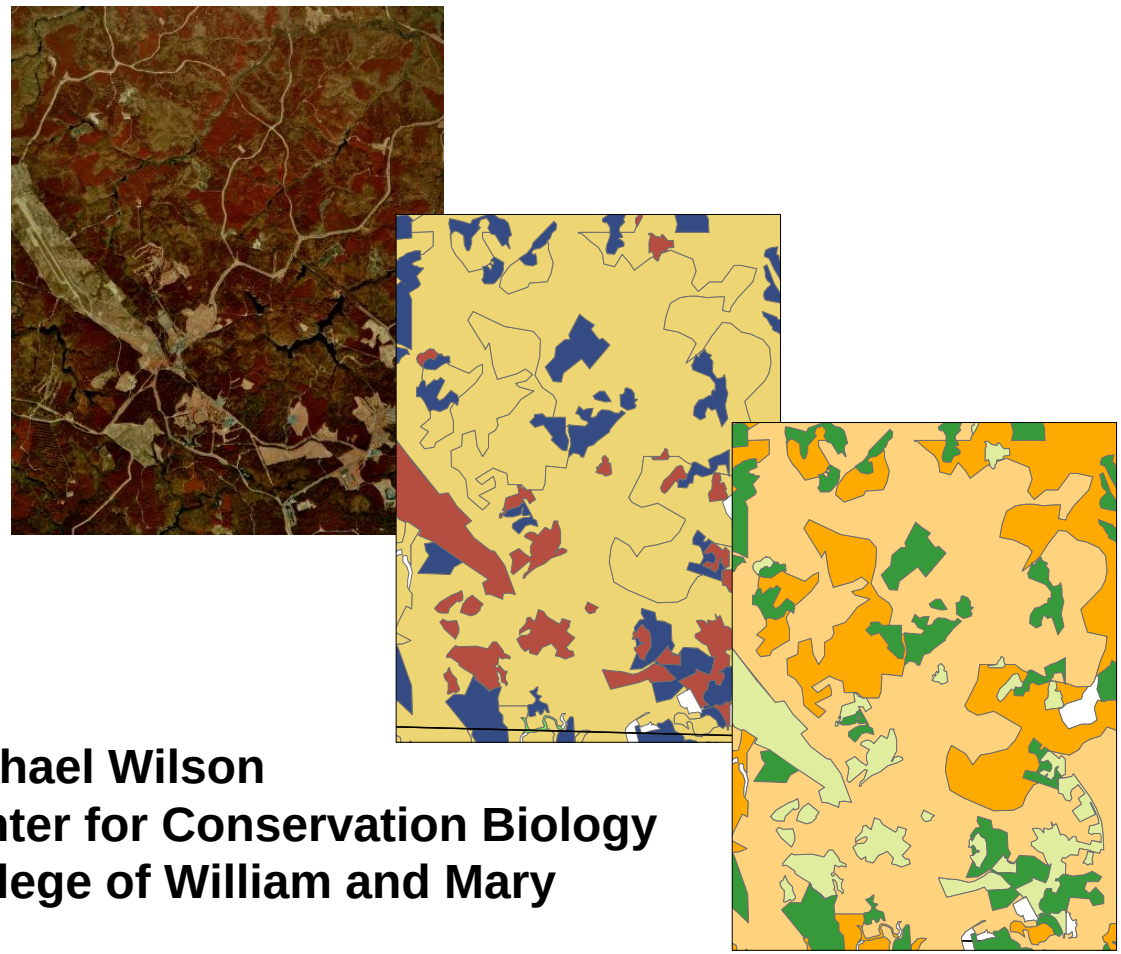
Resolving habitat classification and structure using aerial photography



Michael Wilson
Center for Conservation Biology
College of William and Mary

Aerial Photo-interpretation

Digitizing features of aerial photos for GIS compatibility and measurement

- land cover
- fine-scale habitat structure and classification
- patch metrics

- to augment or as alternative to national digital spatial land cover products

National Land Cover Data Setbacks

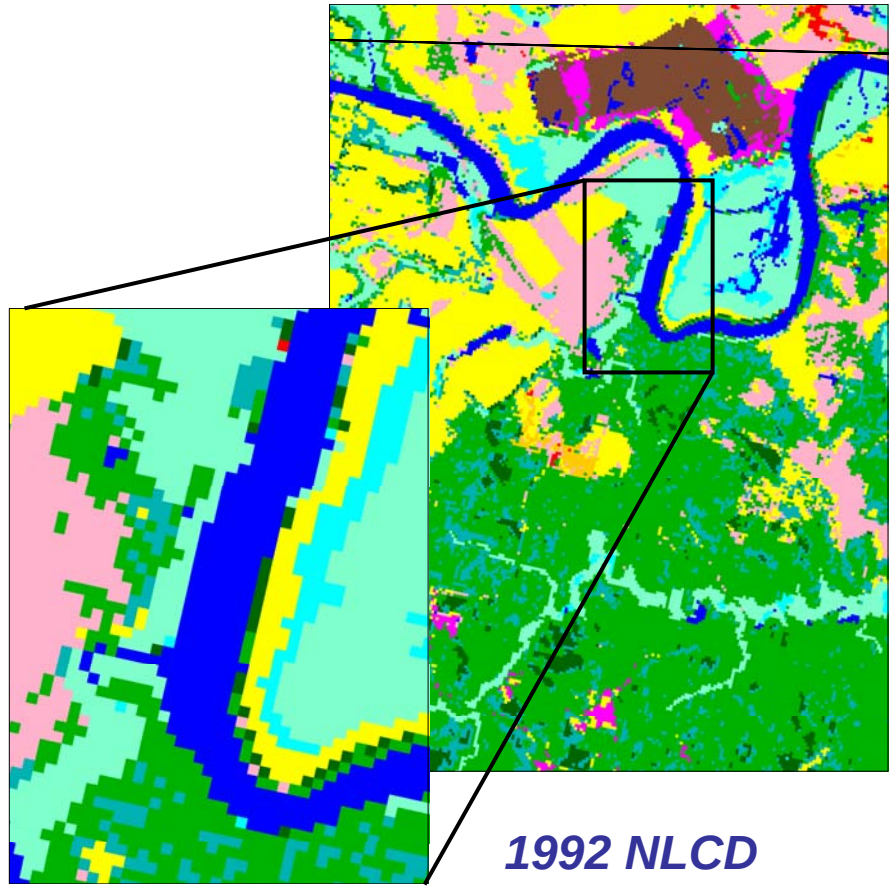
Inconsistent classification

Limits to classification

- **Habitat Type**
- **Habitat Structure**

Resolution

- **Boundary discrepancies (fuzzy edges)**



1992 NLCD

Classification Accuracy *1992 NLCD* Upper Midwest

(*L. Yang as cited in W. Thogmartin et al. 2004*)

	Omission error	Commission error
Grassland & Herbaceous	97%	91%
Herbaceous Wetlands	59%	41%

Classification Limits to Large-scale Population Estimation and Conservation Design

Native Grassland
versus
Pastureland / Hay

Poor predictive quality

Increase in variance of estimate

Decreased Confidence in index of landscape suitability

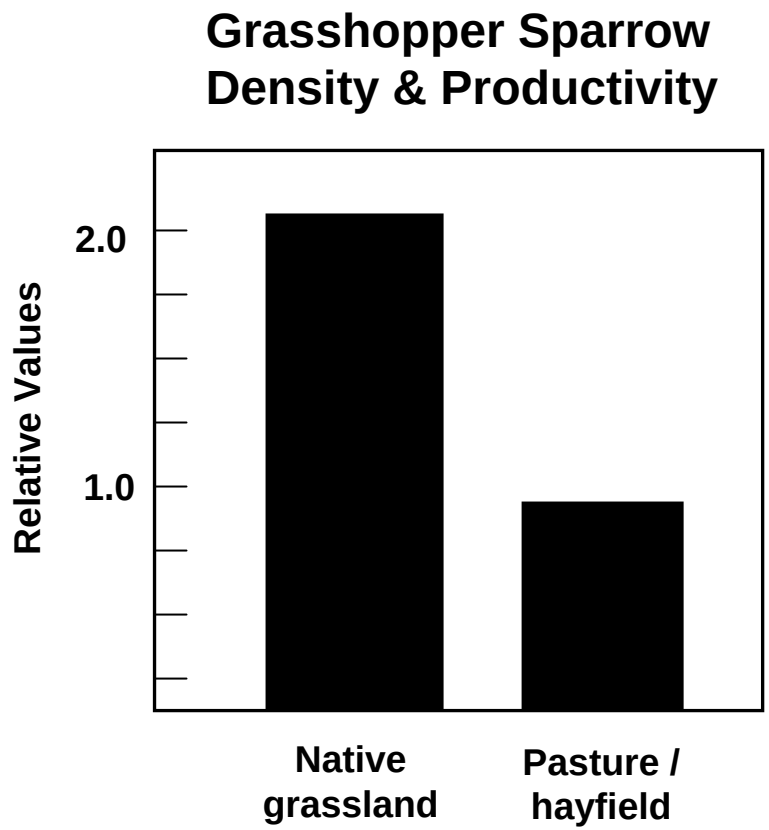
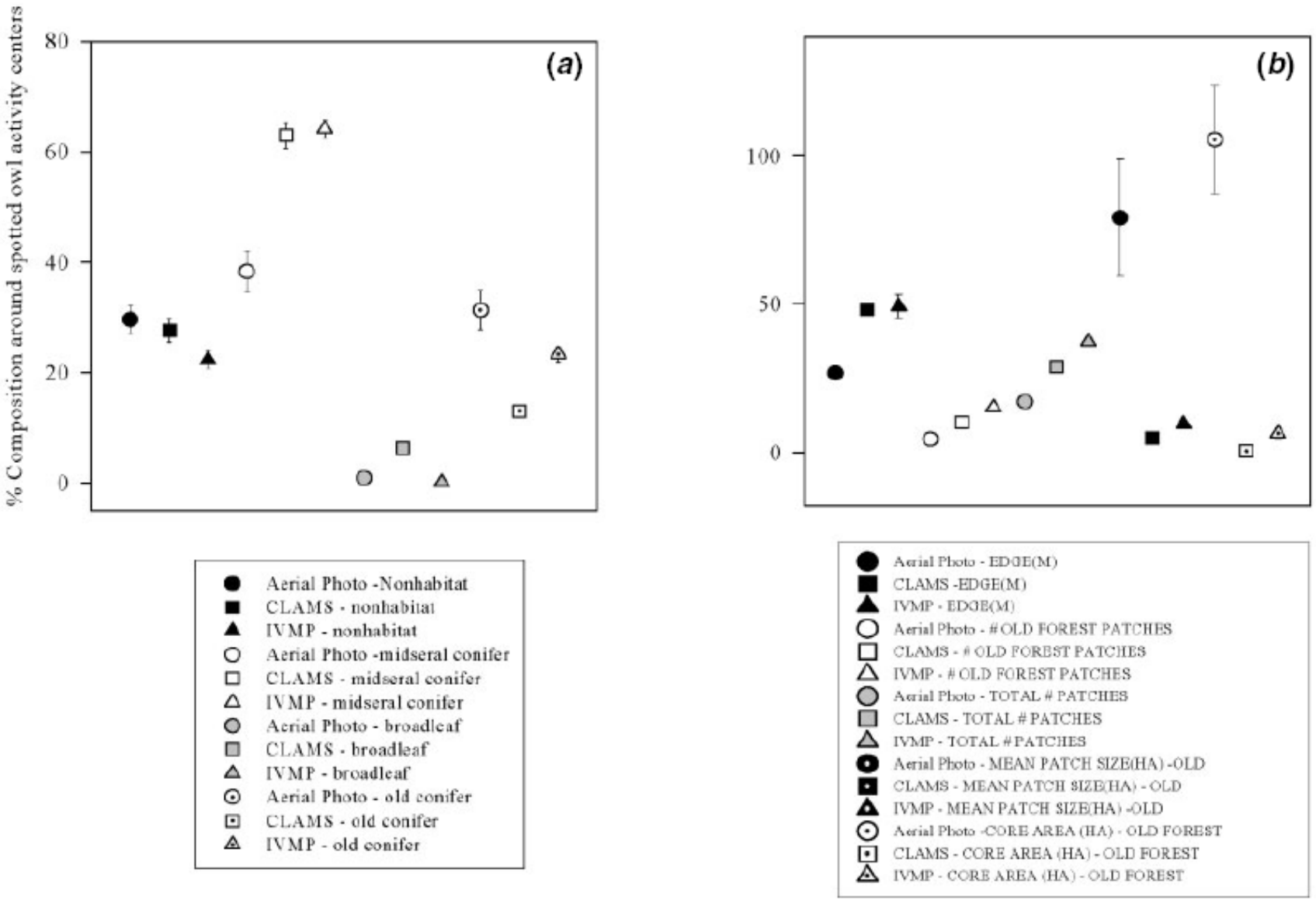


Photo-interpretation (human analyst)	Quantitative analysis (computer)
Trained, knowledge-based observer	Unsupervised classification & regression model training
Larger scale relative to pixel size	Pixel level discrimination
Shape – patch easily determined	Shape determined by software decisions
Limited spectral analysis	True multispectral analysis
Limited distinction of brightness	All available brightness levels

Analysis largely based on ability to distinguish contrast and resolution

Comparison of photo-interpretation and quantitative analysis



E. Glenn and W. Ripple 2004, Wildlife Society Bulletin

Photo-interpretation for Large-scale Analysis

Benefits

Improved Classification
Habitat types, subtypes, seral stages
Better Definition of Patch Boundaries

Drawbacks

Human subjectivity
Inconsistency between observers
Photo Availability (season)
Photo Quality
Time & $$$

Photo Availability

National Programs

National Aerial Photography Program (NAPP)
1987 – present

National High Altitude Photography
1980-89

USGS Digital Orthophoto Quandrangles (DOQQs)
late 1980 -early 1990

High Resolution Orthoimagery (Base Map imagery)
2002-03

Local Photo-sets

USDA, NOAA, NASA, and others

DOQQs

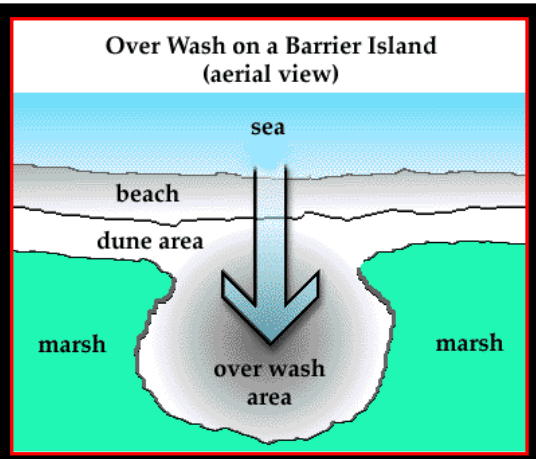
Mosaic of individual 7.5 minute quadrangle images

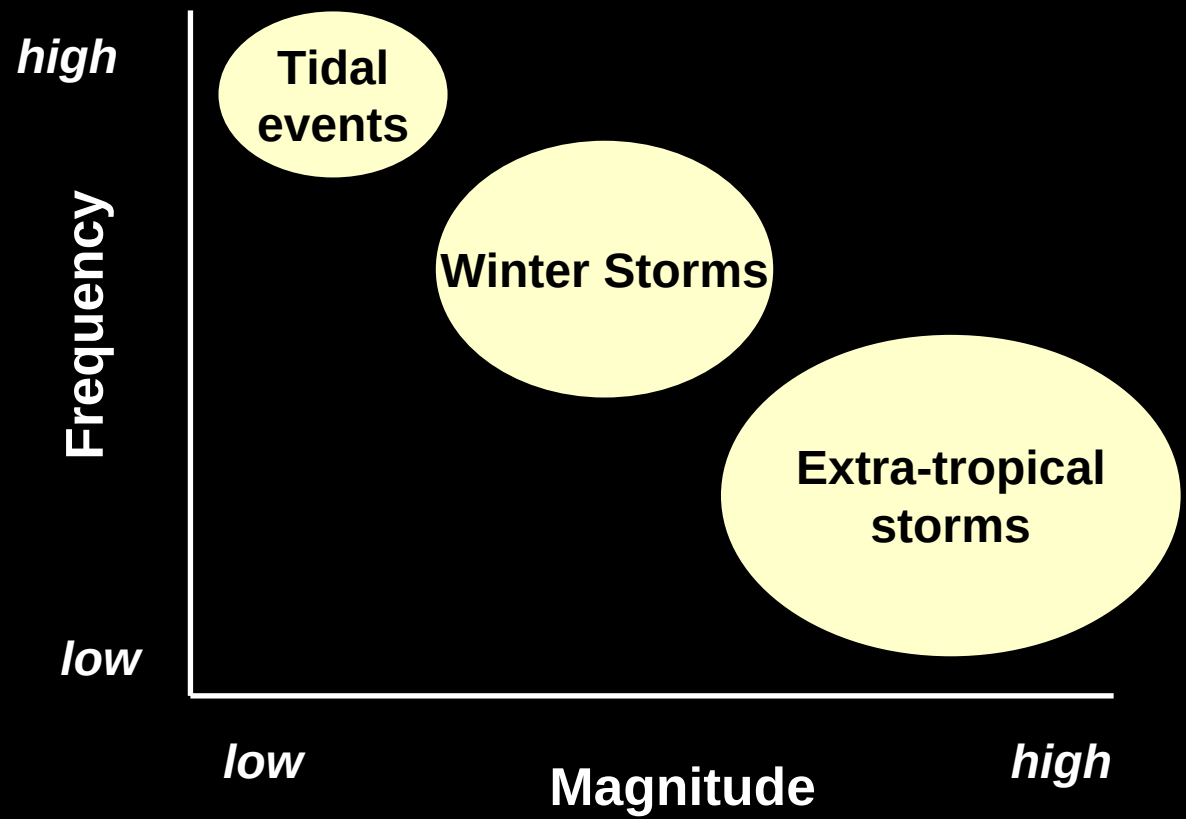
1-m ground resolution

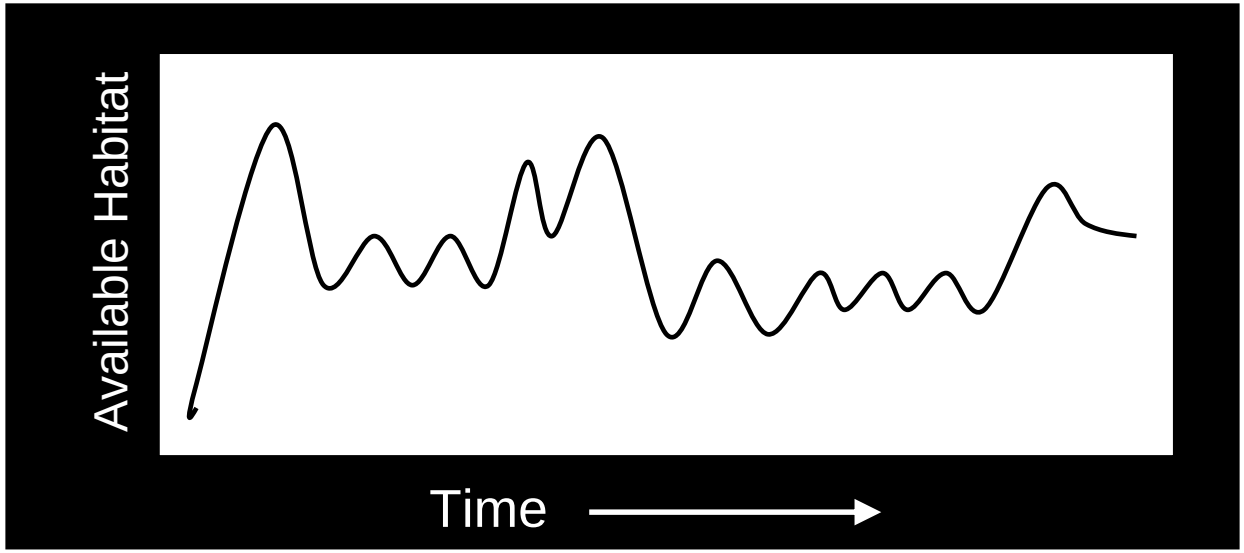
Base Map Imagery

Rural - 1:4,800 scale, 2ft resolution
Suburban – 1,2400 scale, 1ft resolution
Urban – 1:1,200 scale, ½ ft resolution

Determining Tempo and Magnitude of Disturbance for Dependent Species

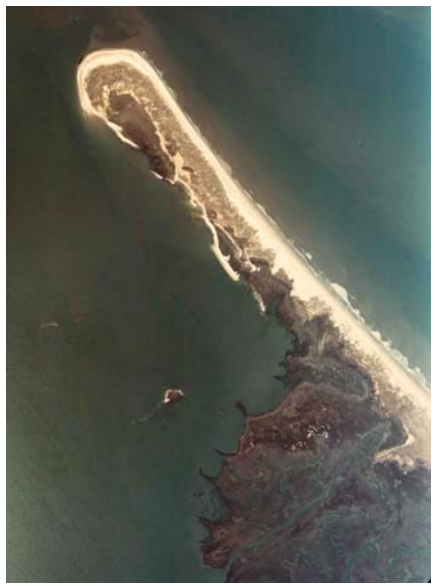






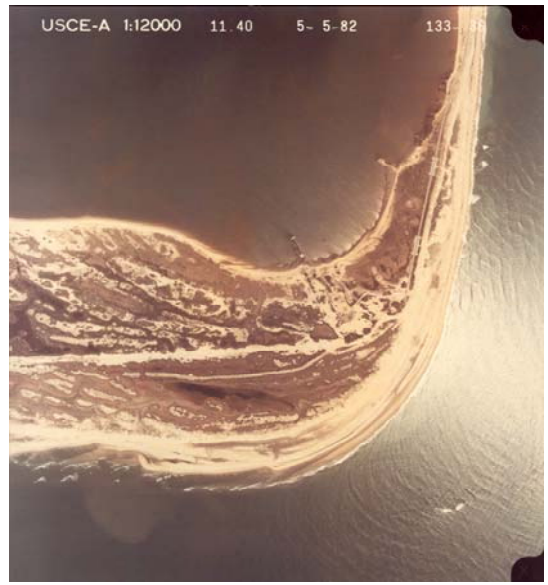
North end of Wreck Island

1977 **1982** **1985** **2004**

Preparing raw photos for GIS measurement and analysis

Scan Historical Photo Sets
600 dpi



Ortho-rectification - planimetrically correcting raster as a 2-dimensional representation

Camera model definition
Digital Elevation Model
Reliable Control Points

Geo-rectification - assigning each pixel to a geographic coordinate

Tie points for relational space

Mosaicking – tie multiple images together

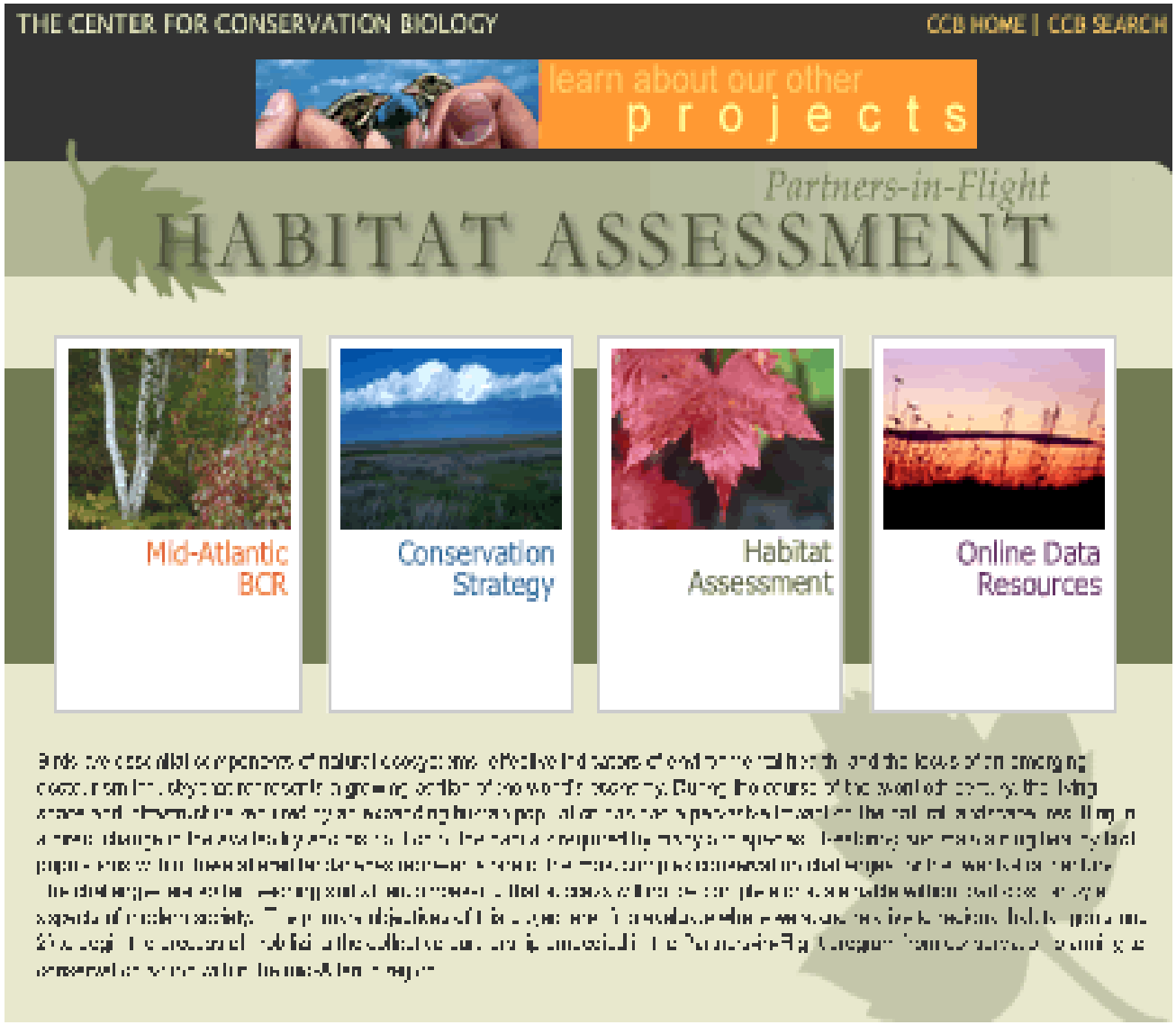
Parameters for measurement

Beach width
Washover fan dynamics
Patch configuration

1977

1985

1994



U.S. FISH & WILDLIFE SERVICE

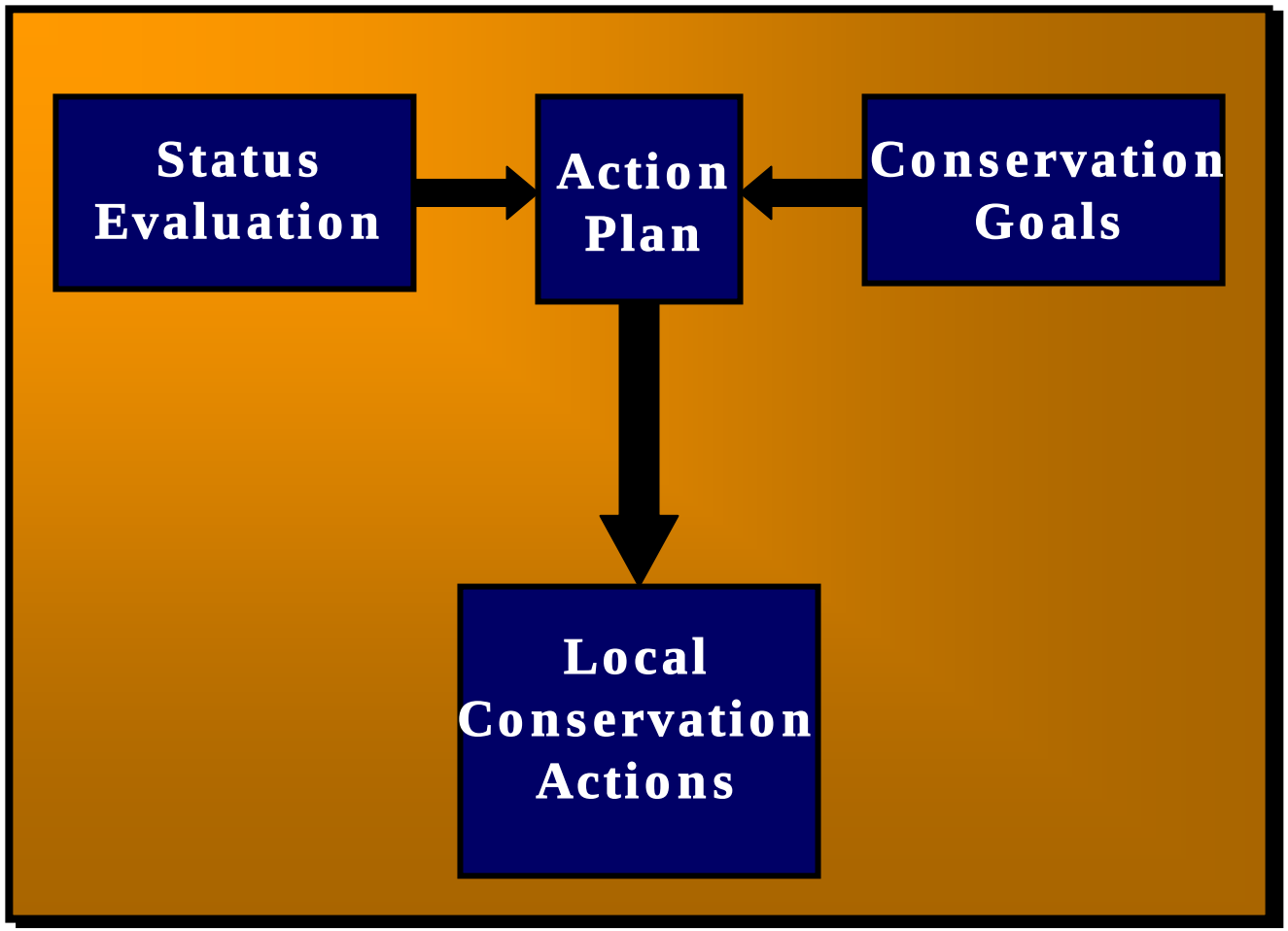
AMERICAN BIRD CONSERVANCY
CONSERVING WILD BIRDS AND THEIR HABITATS THROUGHOUT THE AMERICAS

THE CENTER FOR CONSERVATION BIOLOGY AT WILLIAM & MARY

Bryan Watts
Dana Bradshaw
(see Asilomar proceedings)

www.ccb-wm.org

Mid-Atlantic Conservation Action



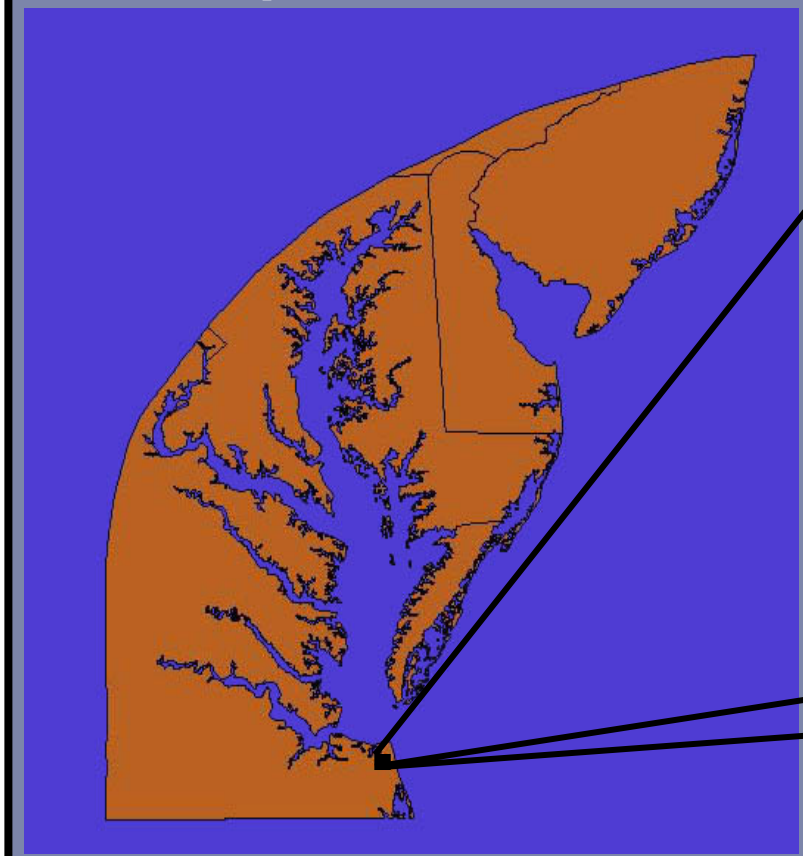
Regional Landscape is Highly Fragmented

How do we mobilize patchwork to achieve regional goals?

Need for Translation Across Scales

Scaling Down Goals
(Information Problem)

Spatial Extent



Spatial Resolution

Habitat Assessment Objectives

1. Identify all land holdings of PIF Partners within region.
2. Identify land managers / contacts for partner-owned lands.
3. Assess partnership lands with respect to designated priority habitats.
4. Determine status of PIF-owned lands relative to regional conservation goals.
5. Deliver information resources to partners to facilitate comprehensive planning.

Habitat Assessment Methodology

1. PIF partners contacted for land and land manager information.

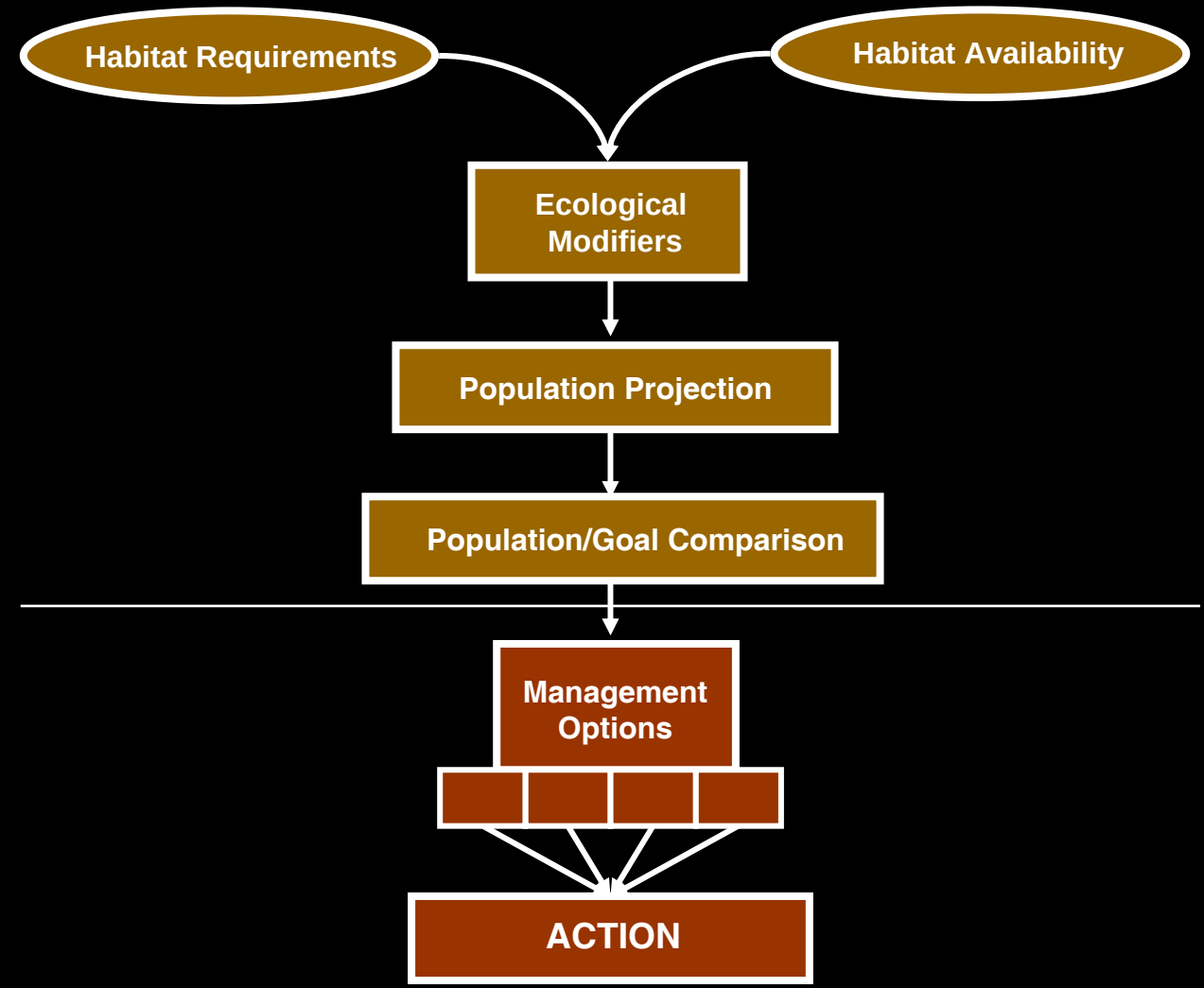
2. DOQQ photography acquired covering regional land base.

3. Imagery evaluated for distribution, acreage, and condition of priority habitats as designated in physiographic area plan.

4. Database and digital data layers generated and standardized.

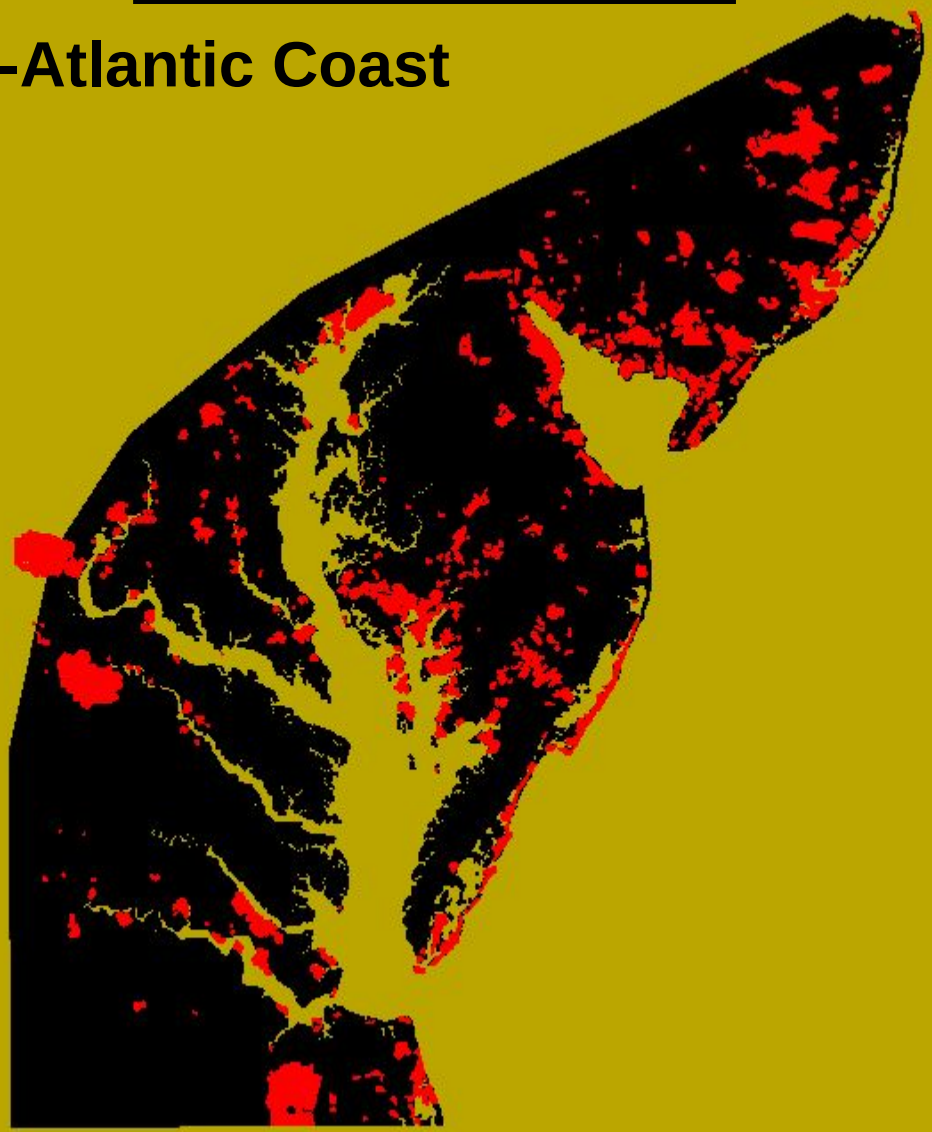
5. Data compared against regional habitat goals for development of management prescriptions.

STATUS EVALUATION
(Conceptual Model)



PIF Collective

Mid-Atlantic Coast

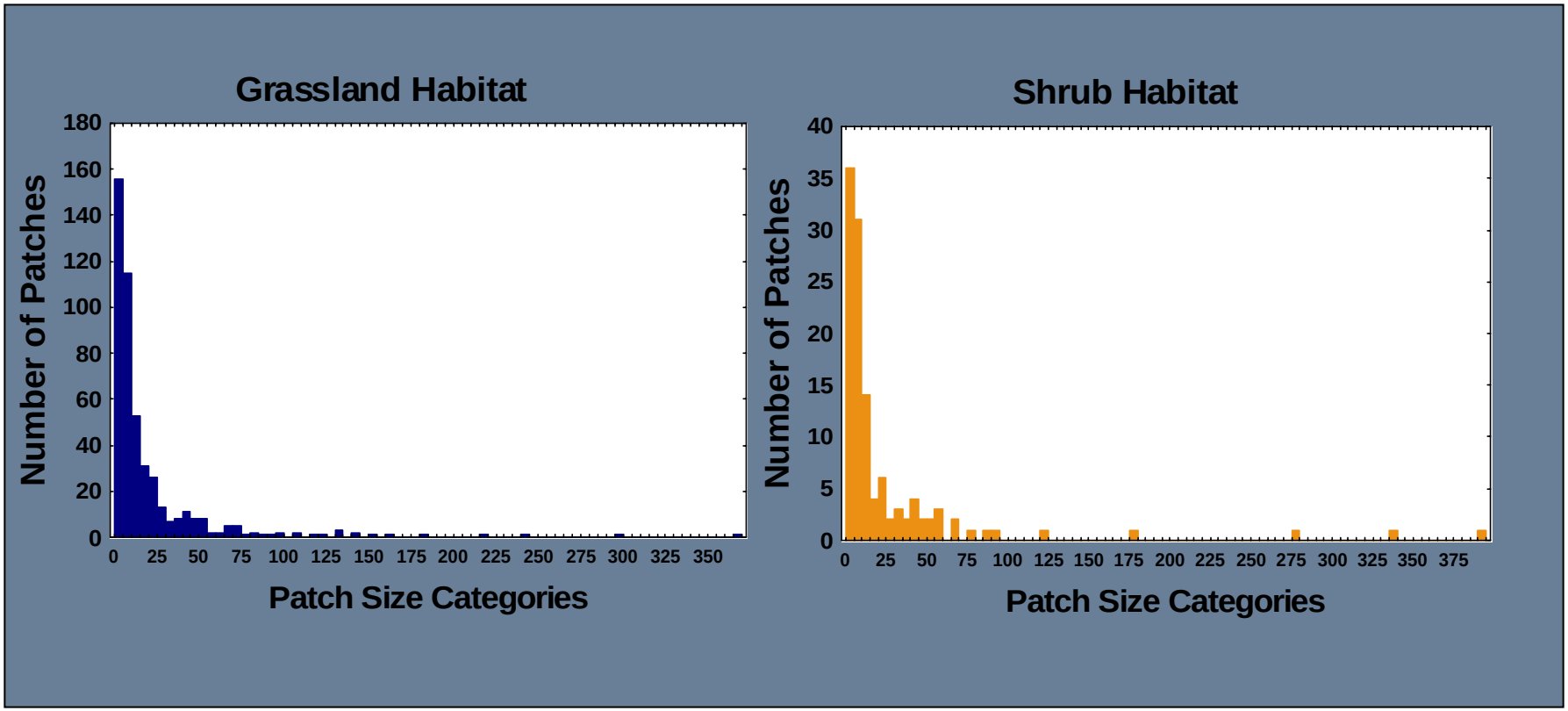


Mid-Atlantic Coast PIF Collective Habitats and Partners

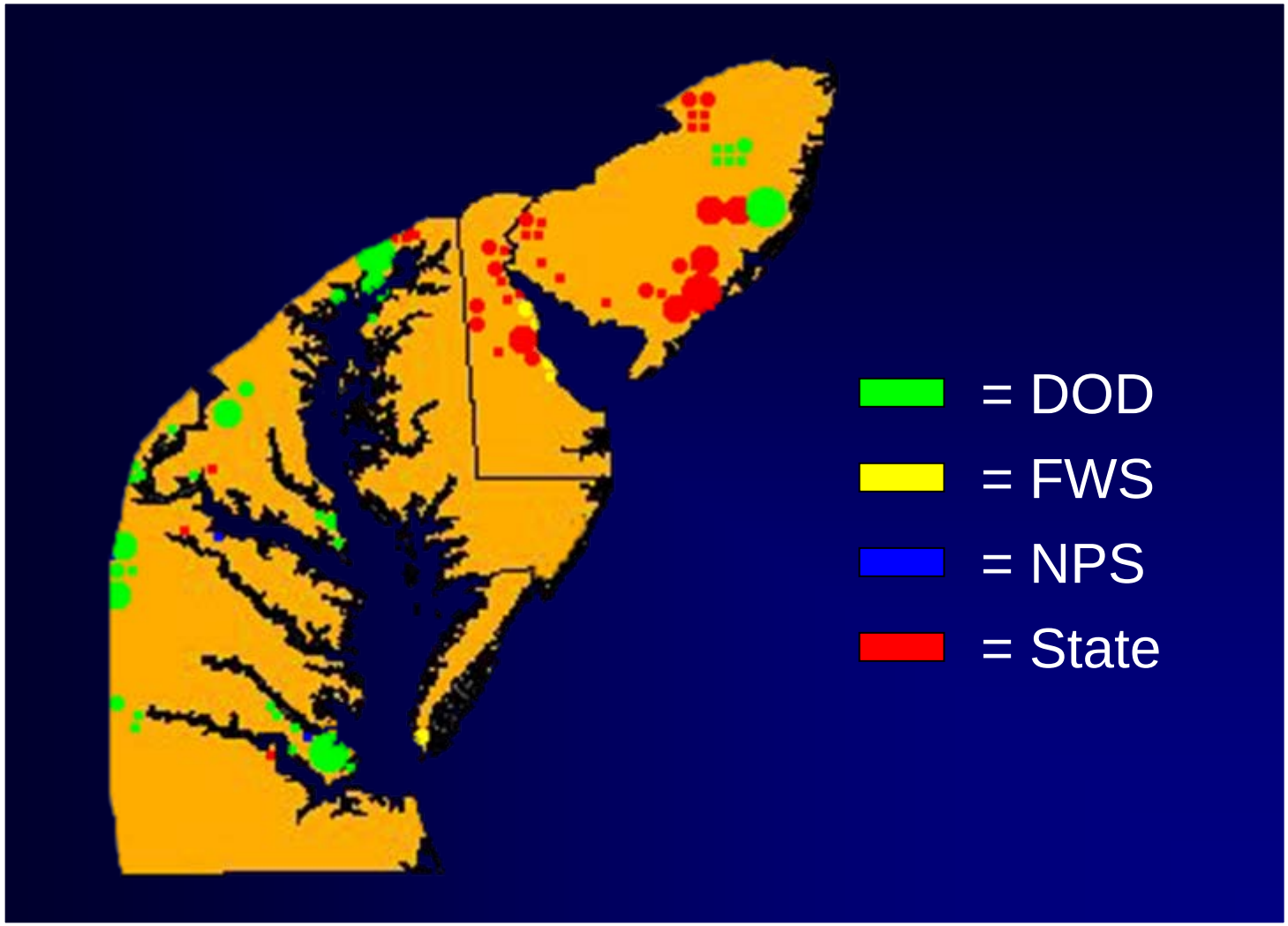
Total Lands: 5,567,380 ha **Collective: 549,955 ha, 636 properties, 18,001 patches**

Partner	Pine Savanna	Barr/Bay Island	Salt Marsh	Forested Wetland	Upland Forest	Early Succ.	Pine Plantation	Fresh/Brack Marsh
VA	325	4	4,738	1,374	1,939	360	1,273	872
MD	58	113	21,109	13,816	18,516	9,002	5,276	4,770
DE	715	-----	2,077	1,046	2,609	4,517	1,758	5,164
NJ	-----	74	22,617	17,026	30,477	8,696	67	942
DOD	202	311	2,603	12,261	69,980	15,797	6,943	5,699
FWS	375	1,652	24,662	45,682	4,725	5,126	1,762	10,105
NPS	436	1,604	1,662	1,140	8,191	1,046	297	606
NGO	545	1,839	7,898	6,555	4,080	1,214	488	1,039
IND	-----	-----	-----	-----	12,000	-----	110,000	-----
TOT	2,656	5,597	87,366	98,900	152,517	45,758	127,864	29,197

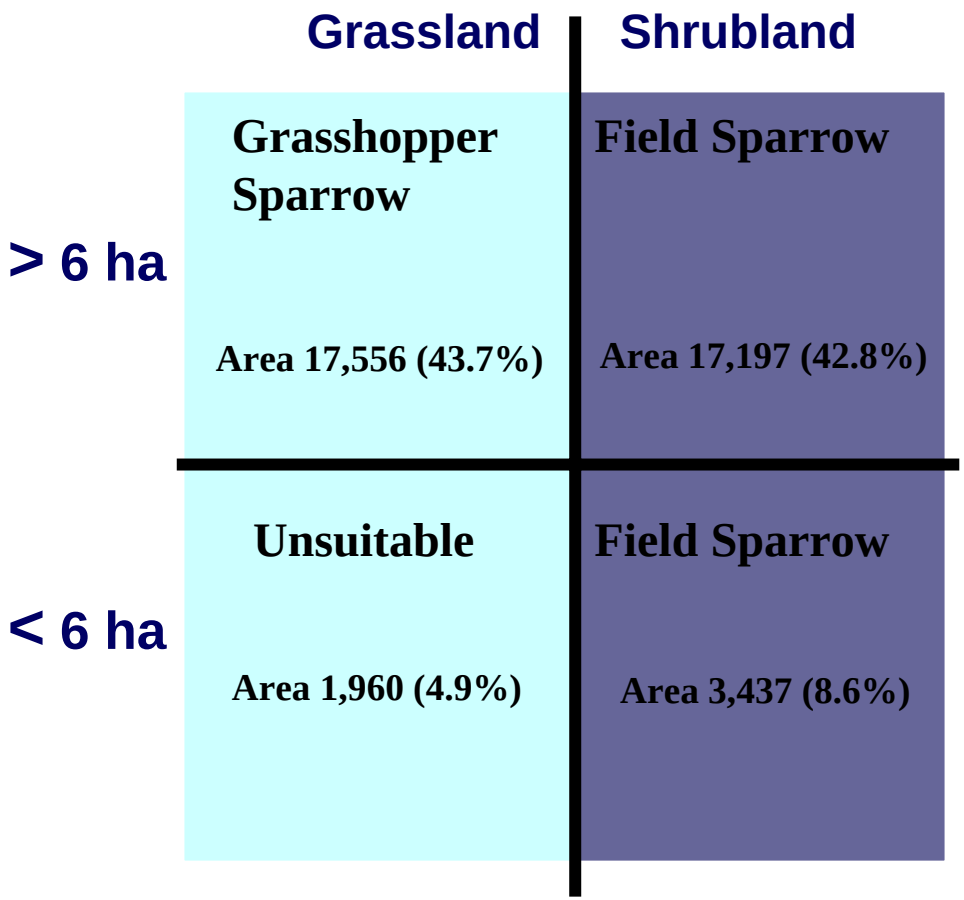
Early Successsional Patch Size Distribution



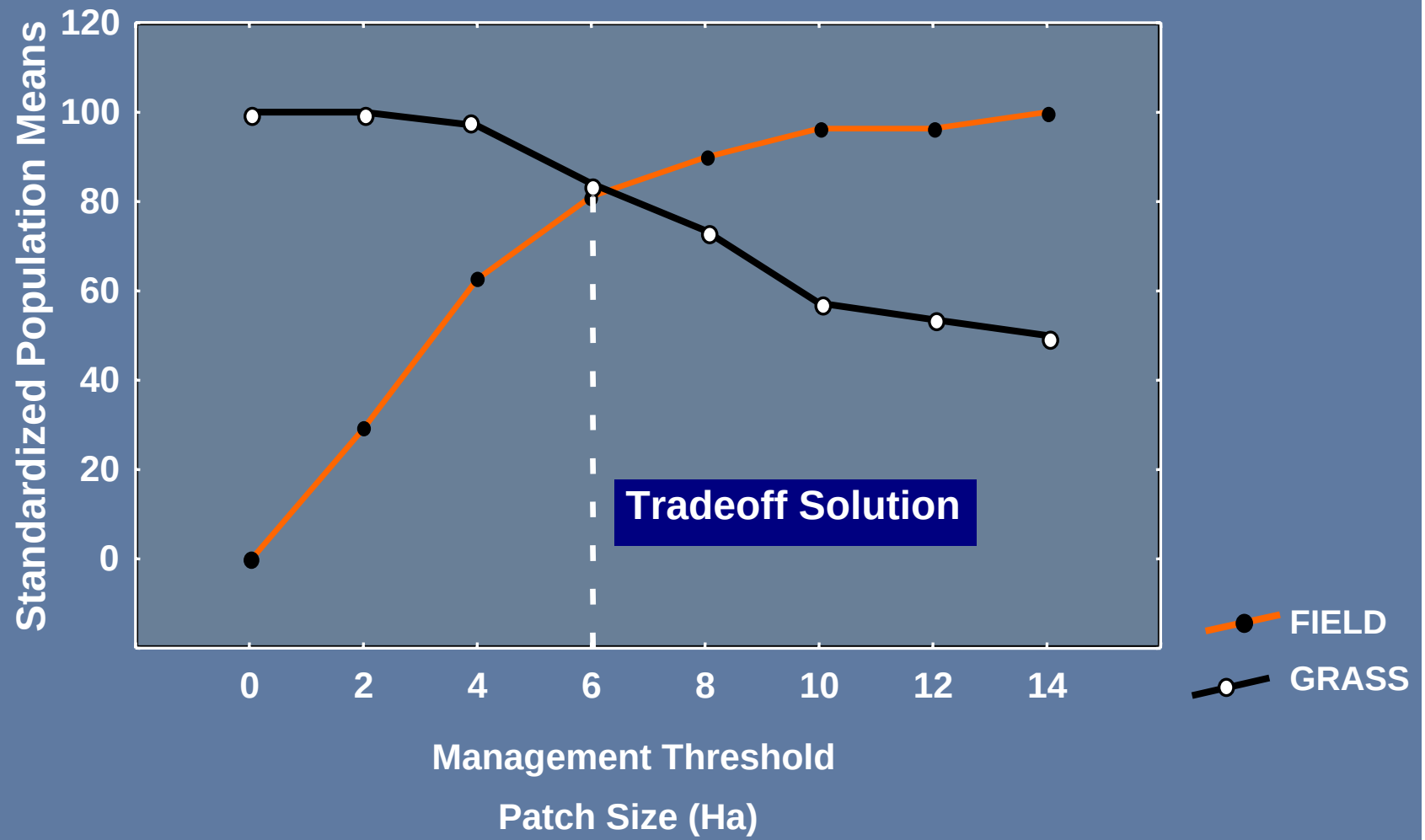
HENSLOW'S SPARROW HABITAT PATCH MAP (Patches > 50 ha)



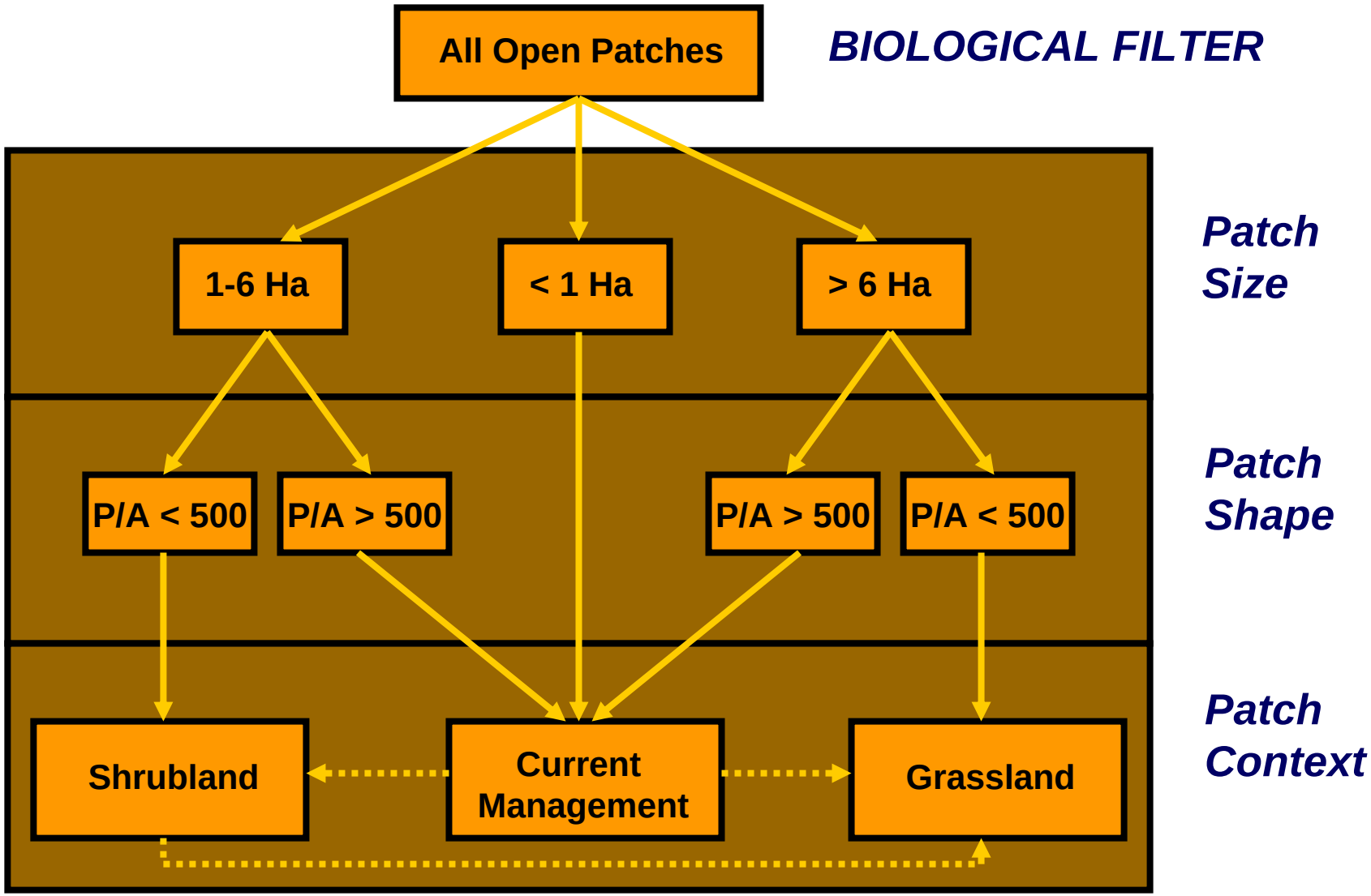
COMPATIBILITY ASSESSMENT



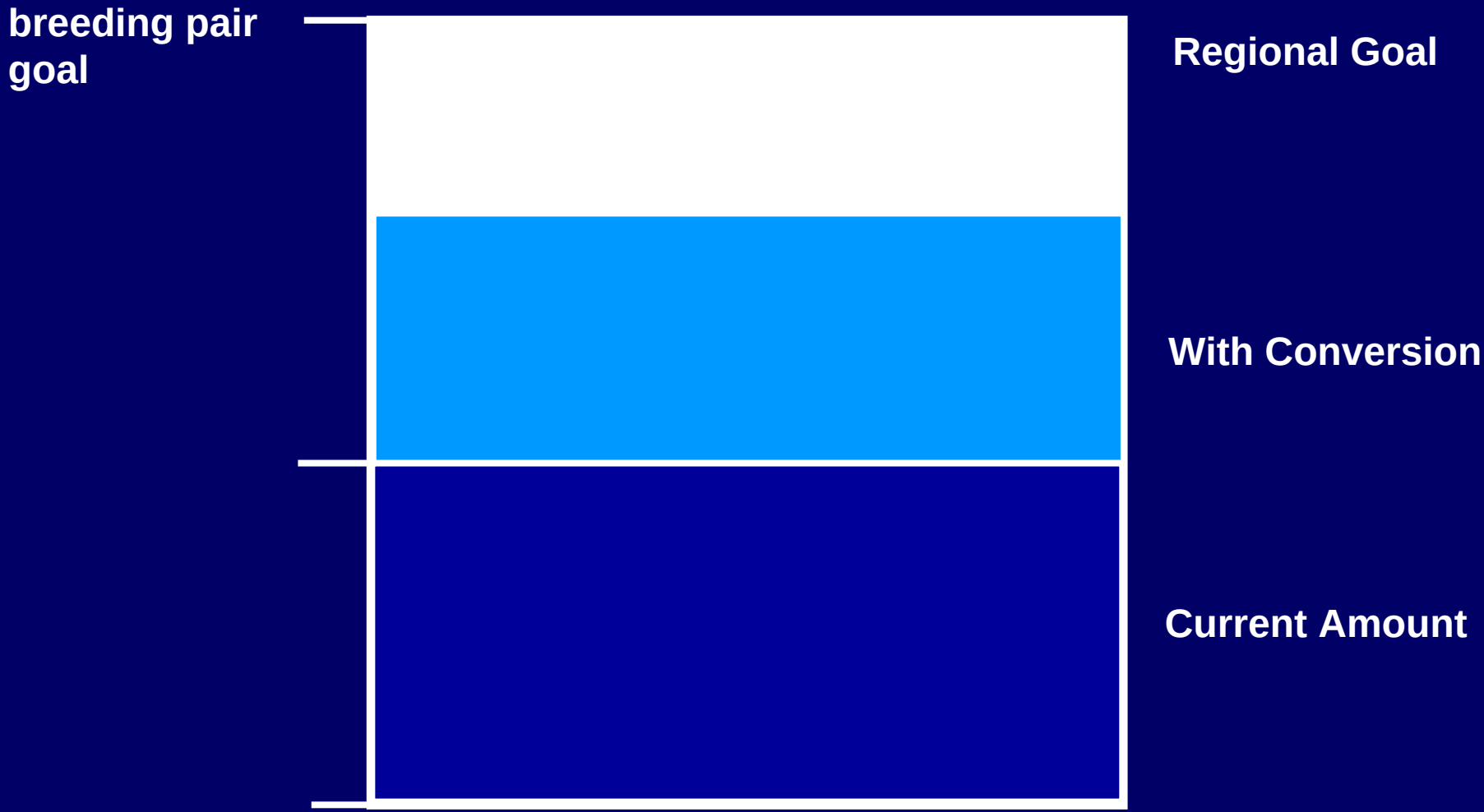
POPULATION RESPONSES TO MANAGEMENT THRESHOLDS



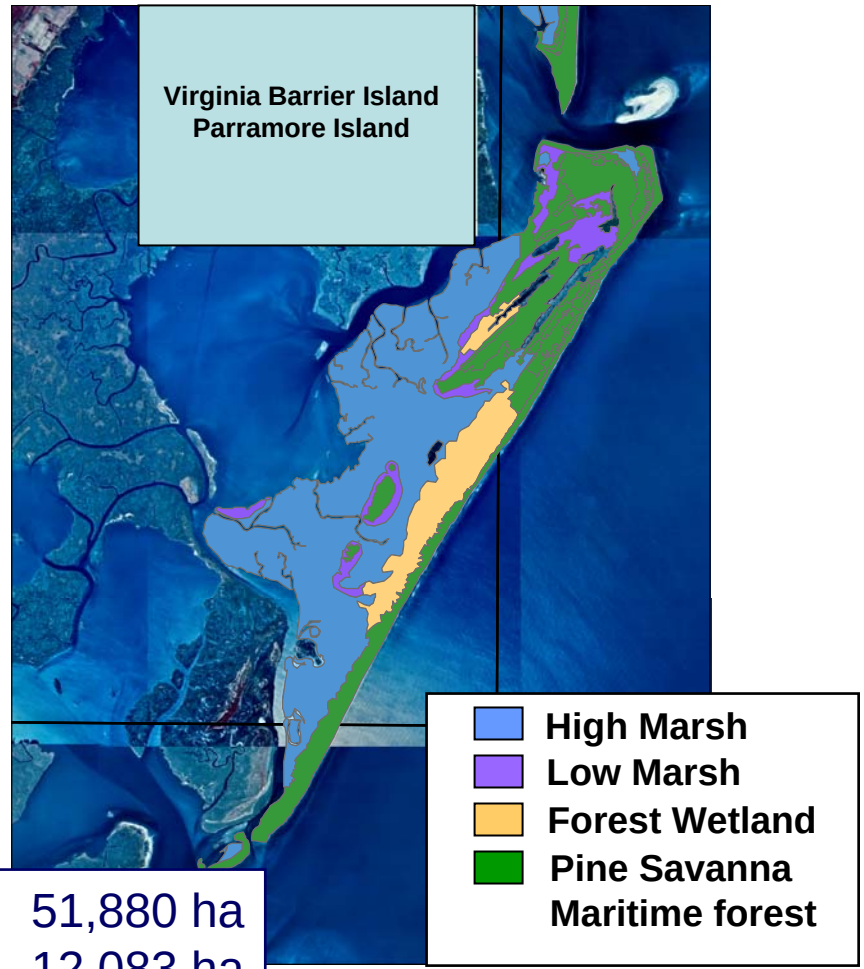
Management Decision Model



STATUS EVALUATION
(Grasshopper Sparrow)

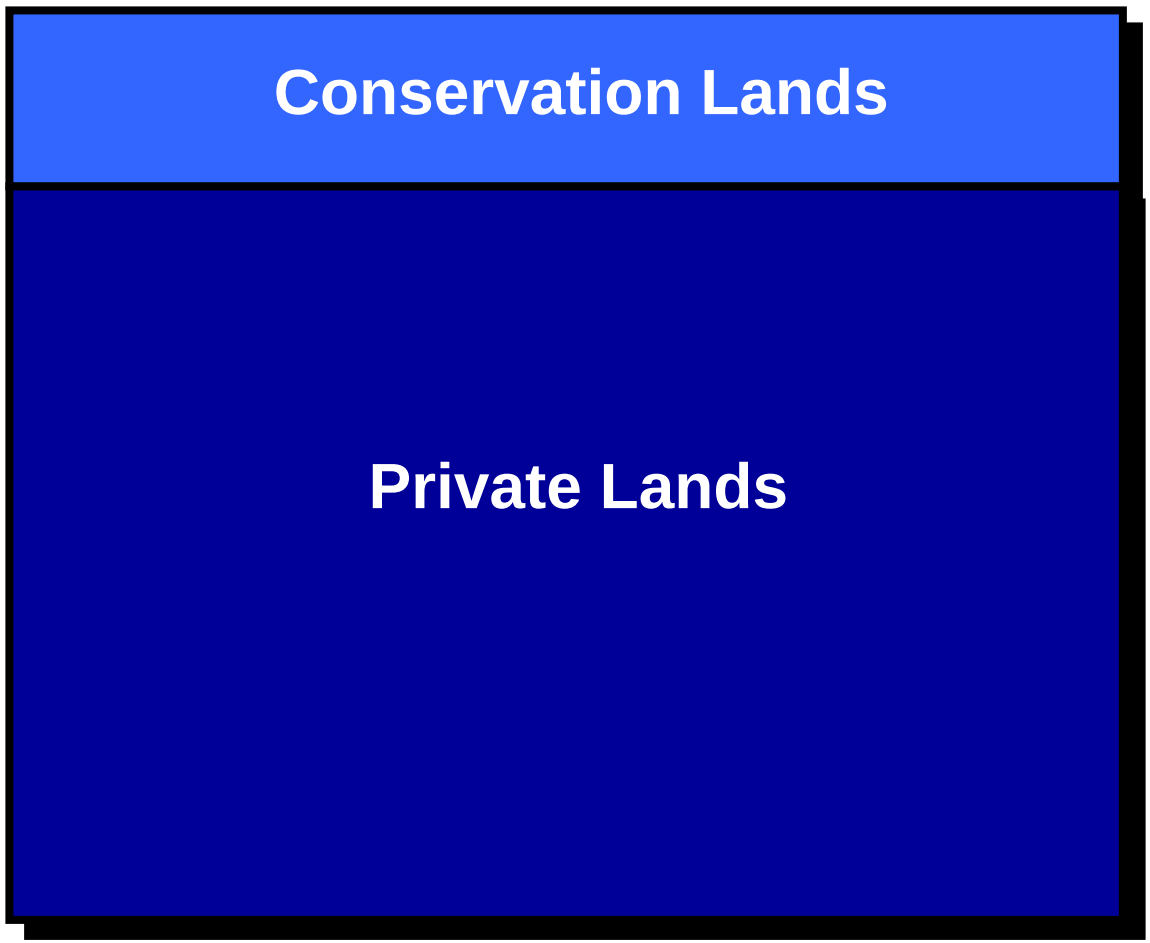


Detailed Classification of Wetland Types



High Marsh	51,880 ha
Low Marsh	12,083 ha

Land ownership



Aerial Photo-interpretation for Large Scale Habitat Assessments

Information based-needs:

when resolution needed is greater than available from national digital land cover products

Strategies to Minimize Costs:

stratified random sampling strategies that subsample class types or patch metrics across landscapes